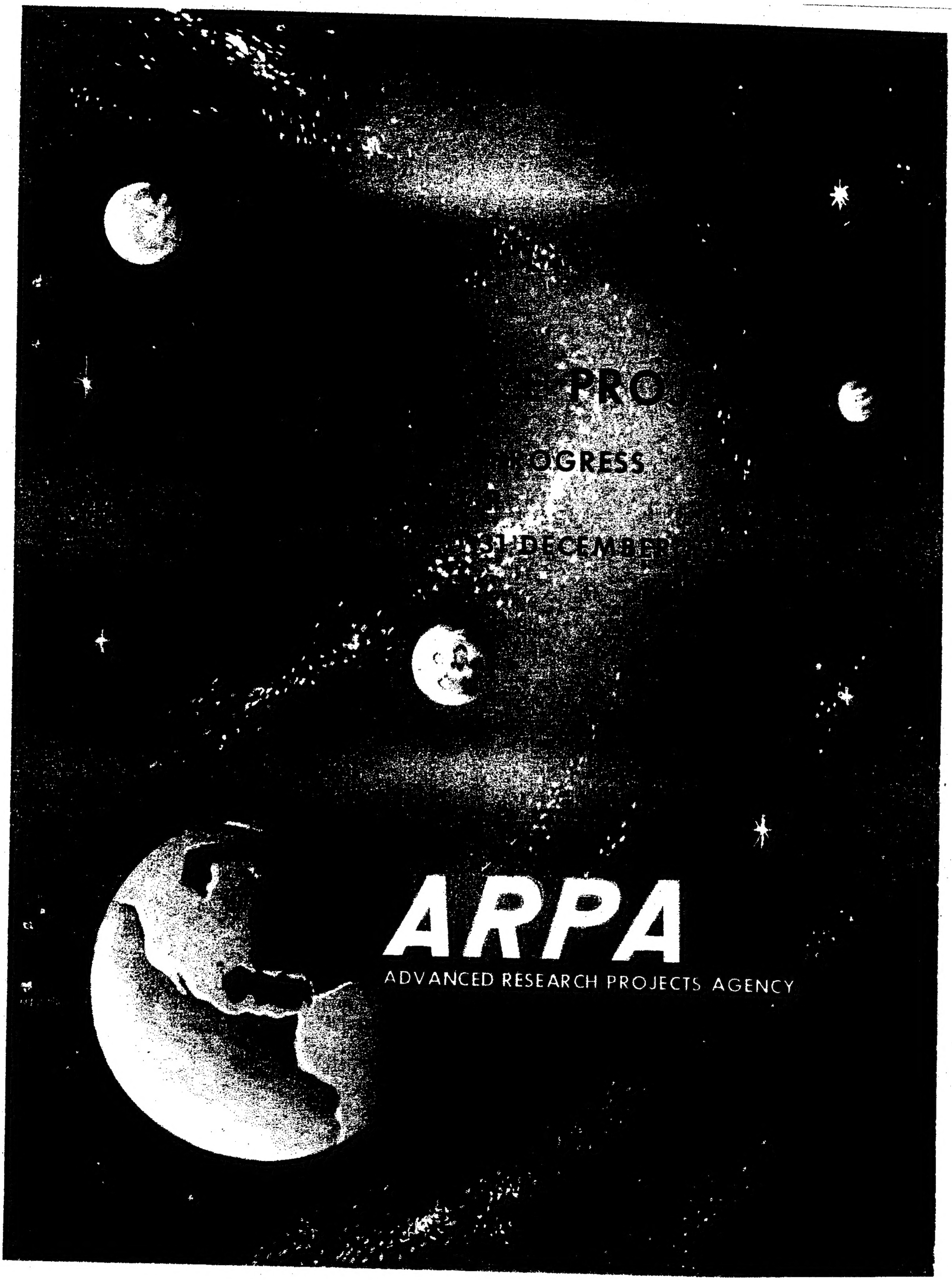

PRO

OGRESS

31 DECEMBER

ARPA

ADVANCED RESEARCH PROJECTS AGENCY

SECRET

ARPA

MILITARY SPACE PROJECTS

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QUARTER ENDED 31 DECEMBER 1959

Department of Defense
Washington 25,D.C.

SECRET

ADVANCED RESEARCH PROJECTS AGENCY
WASHINGTON 25, D. C.

25 January 1960

MEMORANDUM FOR THE SECRETARY OF DEFENSE

SUBJECT: Progress Report on Military Space Projects for Quarter Ended December 31, 1959

This transmits the Military Space Projects Report for the quarter ended December 31, 1959.

During the past quarter, decisions were made to transfer a number of military space projects from the management cognizance of the Advanced Research Projects Agency. As a result of these transfers, it has been determined that future quarterly reports on military space projects will be prepared by the Office of the Director of Defense Research and Engineering. ARPA and the military services will furnish necessary data to ODDR&E on space projects under their cognizance.

Highlights of major events occurring during the quarter are covered briefly in the attached draft of your letter which will transmit the report to the President.

A. W. Betts

A. W. Betts
Brig. General, USA
Director

1 Inclosure:
Quarterly Report on
Military Space Projects

~~SECRET~~

THE SECRETARY OF DEFENSE
WASHINGTON

January 26, 1960

Dear Mr. President:

I am forwarding herewith the Military Space Projects Report for the quarter ended December 31, 1959.

The DISCOVERER VII was launched successfully into orbit from the Pacific Missile Range on November 7, 1959. Due to a power failure, the vehicle tumbled, thus making it impossible to eject the recovery capsule. DISCOVERER VIII, launched on November 20, 1959, also achieved orbit. Because the orbital period was greater than planned, the recovery capsule was ejected on the fifteenth pass. Aircraft and a surface ship tracked the capsule beam after ejection, but the signal was lost after a short time and no contact was made. The next DISCOVERER launch is scheduled for January 29, 1960, following extensive modifications aimed at correcting earlier problems.

The second navigation satellite, TRANSIT, is scheduled to be launched in April 1960 from the Atlantic Missile Range.

In the SATURN Project (clustered booster), configuration of the upper stages has been approved and it has been determined that all upper stages will be fueled with hydrogen-oxygen propellants. Testing of all H-1 engines has been successfully completed, and the full eight-engine captive test firing is scheduled for April 1960.

With great respect, I am

Faithfully yours,

/s/ James H. Douglas
Deputy

1 Inclosure:
Military Space Projects Report

The President

The White House

~~SECRET~~

CONTENTS

Page

PROGRESS HIGHLIGHTS 1

TOPICAL SUMMARY

DISCOVERER (Component Testing Satellite) 3

SAMOS (Reconnaissance Satellite) 6

MIDAS (Very Early Warning Satellite) 9

TRANSIT (Navigation Satellite) 12

NOTUS (Communication Satellite) 14

SHEPHERD (Tracking Network) 18

LONGSIGHT (Feasibility Studies and Exploratory Research) 20

TRIBE (Vehicle Development and Modification)

SATURN (Clustered Engine) 21

STATUS OF FUNDS 27

LAUNCH SCHEDULE 28

FLIGHT DATA 29

ILLUSTRATIONS

	Figure
DISCOVERER VII Launch	1
Stacking of Major Components AGENA Stage for First SAMOS Flight	2
MIDAS Infrared Scanner	3
TRANSIT Satellite in Shroud	4
SATURN Simulated Booster at ABMA Static Test Tower	5
SATURN Booster Transportation	6
SATURN Blockhouse Construction at AMR	7

PROGRESS HIGHLIGHTS

During the Quarter Ended December 31, 1959

On November 7, 1959, DISCOVERER VII was successfully launched into orbit from the Pacific Missile Range. Due to a cycle power failure, the stabilization system became inoperative and the vehicle tumbled. It was impossible, therefore, to initiate the sequence to eject the recovery capsule. DISCOVERER VIII, launched on November 20, also achieved orbit. The orbital period, however, was greater than planned and the recovery capsule was ejected on the fifteenth pass. Nine aircraft and a surface ship tracked the capsule beacon after ejection, but the signal was lost after a short time and no further contact was made.

In the SAMOS (reconnaissance satellite) Project, modification and checkout of the AGENA second stage has been completed. This vehicle will be used, together with an ATLAS booster, for the first SAMOS launch, now scheduled for June 1960.

The MIDAS (Missile Defense Alarm System) Project flight schedule has been revised to attain higher altitude flights earlier in the development program. Flight 3 is now scheduled to be launched into a 2,000-mile polar orbit.

The second TRANSIT vehicle (navigation satellite) is scheduled to be launched in April 1960 from the Atlantic Missile Range.

The communications satellite project (NOTUS) is undergoing re-evaluation with a view toward the possible elimination of one or more intermediate hardware stages originally planned in the development of the 24-hour satellite - DECREE.

The satellite detection system, under Project SHEPHERD, continues to track satellites in space. DISCOVERER VII came down on November 26, and DISCOVERER VIII is still in orbit. A decision has been made to phase out of the tracking network the doppler system complex, known as DOPLOC.

In the SATURN Project (1.5 million pound cluster engine), configuration of upper stages has been approved. It has also been decided that all upper stages will be fueled with hydrogen-oxygen propellants. Testing of all H-1 engines has been successfully completed, and the full eight-engine captive test firing is now scheduled for April 1960.

During the quarter, decisions were made to transfer military space projects from the management control of the Advanced Research Projects Agency. Projects DISCOVERER, MIDAS and SAMOS have been transferred to the Department of the Air Force. The SATURN project is being transferred to the National Aeronautics and Space Administration. Future reassignments to the military services will be made on the TRANSIT, NOTUS, and SHEPHERD Projects and portions of the LONGSIGHT Project.

TOPICAL SUMMARY

DISCOVERER PROJECT

(COMPONENT TESTING SATELLITE)

INTRODUCTION

Project Objectives - Development and testing of components for Military Space Technology Program.

The objective of the DISCOVERER Satellite Program are to conduct research and development on components, equipment, instrumentation, propulsion, data processing, communications and operating techniques all dealing with military space technology.

The DISCOVERER project is characterized by an open-end series of space flights to be utilized testing classified equipments within the space environment. All of the earlier flights planned for this project will utilize the THOR-IRBM Booster and the AGENA second stage.

DISCOVERER FLIGHTS

DISCOVERERS VII and VIII

DISCOVERERS VII and VIII launched into orbit successfully.

During the quarter DISCOVERERS VII and VIII were launched and placed into orbit. DISCOVERER VII was launched on November 7 (see Figure 1) and DISCOVERER VIII was launched on November 2 both from the Pacific Missile Range. Lift off and first stage trajectory were normal and accurate in both flights and orbital status was achieved, although the DISCOVERER VIII apogee was much higher than planned. These flights represent the fifth and sixth AGENA vehicles to be successfully injected into orbit since February 1959.

Payload recovery efforts unsuccessful.

Although both flights attained orbit successfully, neither of the payload recovery attempts was achieved. Initial telemetry received on the first pass of DISCOVERER VII indicated that a 400 cycle power failure had occurred. As a result, the stabilization system was inoperative and the vehicle was tumbling. Also it was impossible to initiate the ejection sequence. Subsequent investigations indicate that the power failure was probably caused by the load limiter. Because of the greater than planned orbital period, the DISCOVERER VIII capsule was ejected on the fifteenth pass. Nine C-119 aircraft and a surface ship tracked the capsule beacon after ejection, but the signal was lost after a short time and no further contact was made. Subsequent analysis indicated that the vehicle guidance system "hunting" for a stable attitude at the greater than planned apogee resulted in premature exhaustion of control gas. The vehicle, therefore, was improperly oriented at the time of capsule ejection.

DISCOVERER IX

Launch of DISCOVERER IX set for late January.

Launch of DISCOVERER IX is scheduled tentatively in late January. The exact flight date depends upon completion of various planned modifications and delivery of the payload to Vandenberg AFB.

STATUS OF AGENA VEHICLE

Final AGENA "A" vehicle in modification.

The last three AGENA "A" vehicles for the initial DISCOVERER flight design program underwent hot firing at Santa Cruz Test Base (SCTB). Two of these were accepted by the Air Force on November 17 and are now at Vandenberg AFB.

First AGENA "B" vehicle ready for checkout.

The first AGENA "B" vehicle in the follow-on program was essentially ready for modification and checkout at the close of this reporting period. This vehicle has an engine restart capability and includes integral propellant tanks of double the AGENA "A" capacity to permit extended engine burning time.

BIOMEDICAL PROGRAM

Biomedical capsule thermal tests conducted.

Thermal testing of a special biomedical capsule, instrumented to determine thermal resistances throughout the capsule system, was completed on November 25, 1959, in the High Altitude Temperature Simulator. The tests were conducted to determine thermal profile extremes for the biomedical capsule (primate passenger) under anticipated orbital conditions. Initial results indicate that simplification of the system may be feasible. However, it appears that additional water evaporator capacity may be required to satisfy extreme heat flux conditions.

Live specimen testing to be resumed in January.

Biomedical testing with a live primate is expected to be resumed in January, following capsule modifications now being made. Modifications include correction of an air conditioning deficiency which caused the abort of the last test with a live specimen.

FACILITIES

First increment of Test Center completed.

Increment one of the Satellite Test Center (formerly Development Control Center) Sunnyvale, California, was completed and accepted from the construction agency during December. Increment two is scheduled for completion in June 1960.

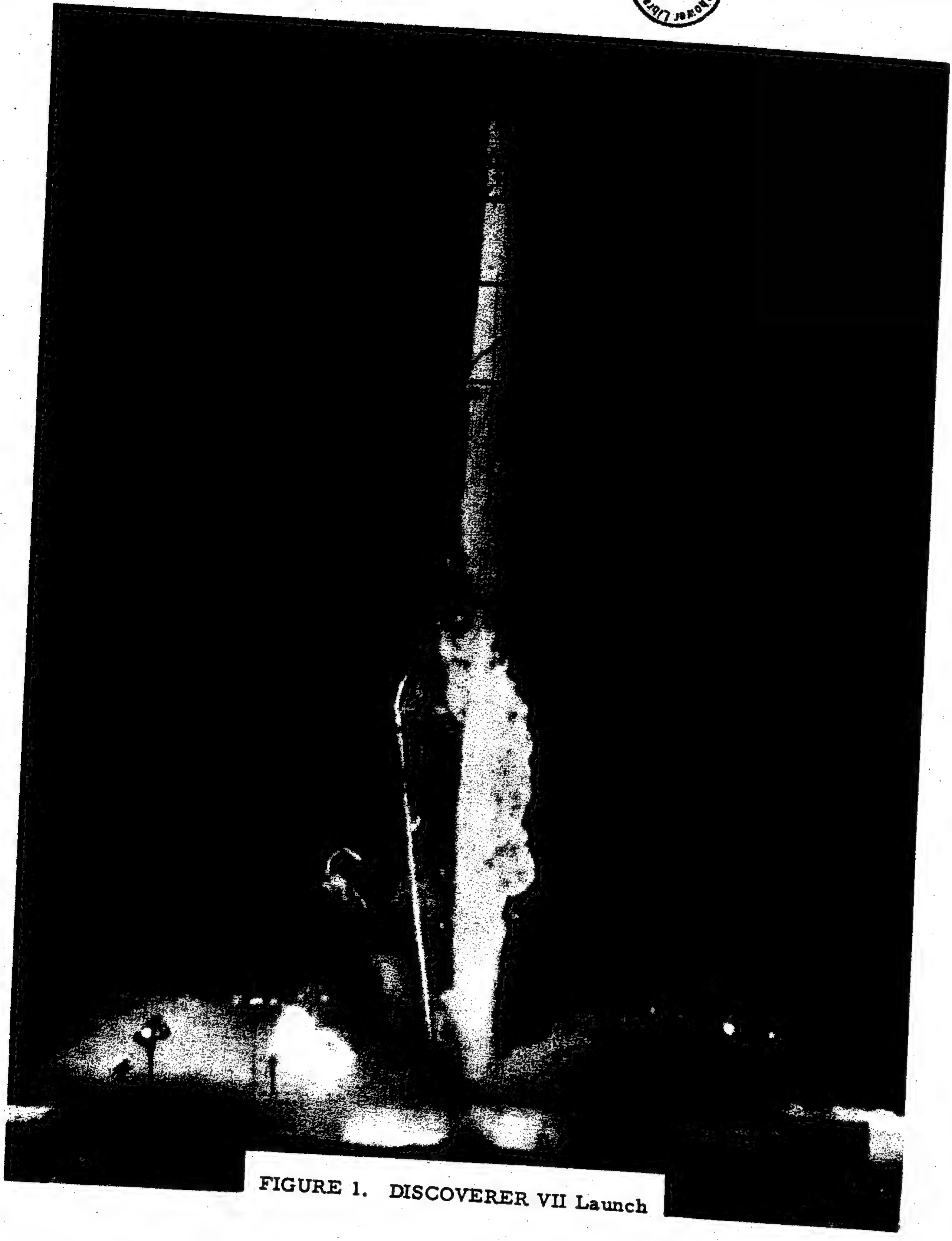

FIGURE 1. DISCOVERER VII Launch

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SAMOS PROJECT

(RECONNAISSANCE SATELLITE)

INTRODUCTION

SAMOS to provide both Visual (Photographic) and Ferret (Electromagnetic) Data.

The objective of the SAMOS project is the development of a reconnaissance system utilizing polar orbiting satellites to collect and process visual (photographic) data and ferret (electromagnetic) data. The SAMOS system is expected to acquire a great amount of technical intelligence regarding enemy military and industrial strength.

Acquisition of data by capsule recovery.

Two approaches are being developed for acquiring intelligence data; (1) the recovery system - for visual data - in which a capsule is ejected from the satellite and recovered, and (2) the electronic data readout system - for both visual and ferret - in which data is transmitted to ground stations.

GENERAL

AGENA vehicle for first SAMOS flight nears completion.

Stacking of the major components of the AGENA second stage for the first SAMOS flight vehicle, shown in Figure 2, was completed on November 6, 1959. Completion of modification and checkout is scheduled for January 1, 1960. Subassembly of the second AGENA vehicle is progressing on schedule. The first SAMOS launch is now scheduled for June 1960.

VISUAL RECONNAISSANCE SYSTEMS

First payload (E-1) operated successfully under orbit conditions.

Following comprehensive testing, the first flyable (E-1) payload was operated successfully for 72 hours under simulated orbital conditions. During subsequent vacuum tests, however, improper installation of a clamping ring assembly resulted in the payload pressure shell being damaged beyond repair. The payload has been diverted for type test use only. Work on the second deliverable E-1 payload has been accelerated for use as the fir flight article. Delivery is scheduled for January 15 1960, to Lockheed.

~~SECRET~~

E-1 payload support equipment installation complete.

All E-1 payload support equipment has been installed in the Sunnyvale checkout area. Personnel are being trained in operation and maintenance of the equipment in advance of the January delivery of the first flyable E-1 payload.

E-2 payload progress on schedule.

Component fabrication and subassembly of the two flyable E-2 payloads with more sophisticated design are proceeding on schedule. Design studies are being made to reduce weight and improve performance of subsequent payloads.

Extensive deliveries of support equipment made at Vandenberg AFB.

Two primary record film processors and auxiliary equipment have been delivered to Vandenberg AFB. Installation will be made in the Missile Assembly Building (for payload checkout) beginning January 5, 1960; and at the tracking and data acquisition station (for orbital test operations) beginning January 12. Other items delivered to Vandenberg AFB include payload handling equipment, payload test support equipment, oscillograph record camera, and 35mm quality evaluation viewer.

Recoverable system parameters being established.

Final design parameters are being established for the E-5 (recoverable photographic reconnaissance system). As presently planned, the E-5 payload will use a mirror system to permit mounting of the panoramic camera lens horizontally while in orbit. The system will use capsule recovery of both the film and camera. Recovery will be initiated no later than thirty days after launch, and the system will include the capability for command recovery any day prior to the thirty day lifetime limit. Recovery will be effected in the Hawaii area on a north-to-south pass. Launch will be from the Pacific Missile Range.

FERRET RECONNAISSANCE SYSTEMS

F-1 payloads in modification and checkout area.

The first two F-1 payloads were delivered to Lockheed on October 23, 1959. These units are in the modification and checkout center undergoing functional testing and preparations for installation in the vehicle. The third F-1 payload is undergoing systems testing and is scheduled for delivery to the Lockheed Missile and Space Division on January 29, 1960.

Training courses completed.

Training courses on the characteristics and operation of the F-1 payload and ground support equipment were completed for modification and checkout personnel and for personnel who will be assigned to Vandenberg AFB.

FACILITIES

Launch stands near completion.

Beneficial occupancy ~~date~~ for Launch Stand No. 1, Point Arguello, California, except for the propellant loading system, is January 1960. Final completion of Stand No. 1 is scheduled for March and Stand No. 2 for April.

Plans and specifications for the Technical Support Building at Vandenberg AFB have been completed. Preliminary concept studies for a Technical Support Building at Point Arguello were completed on December 14, 1959.

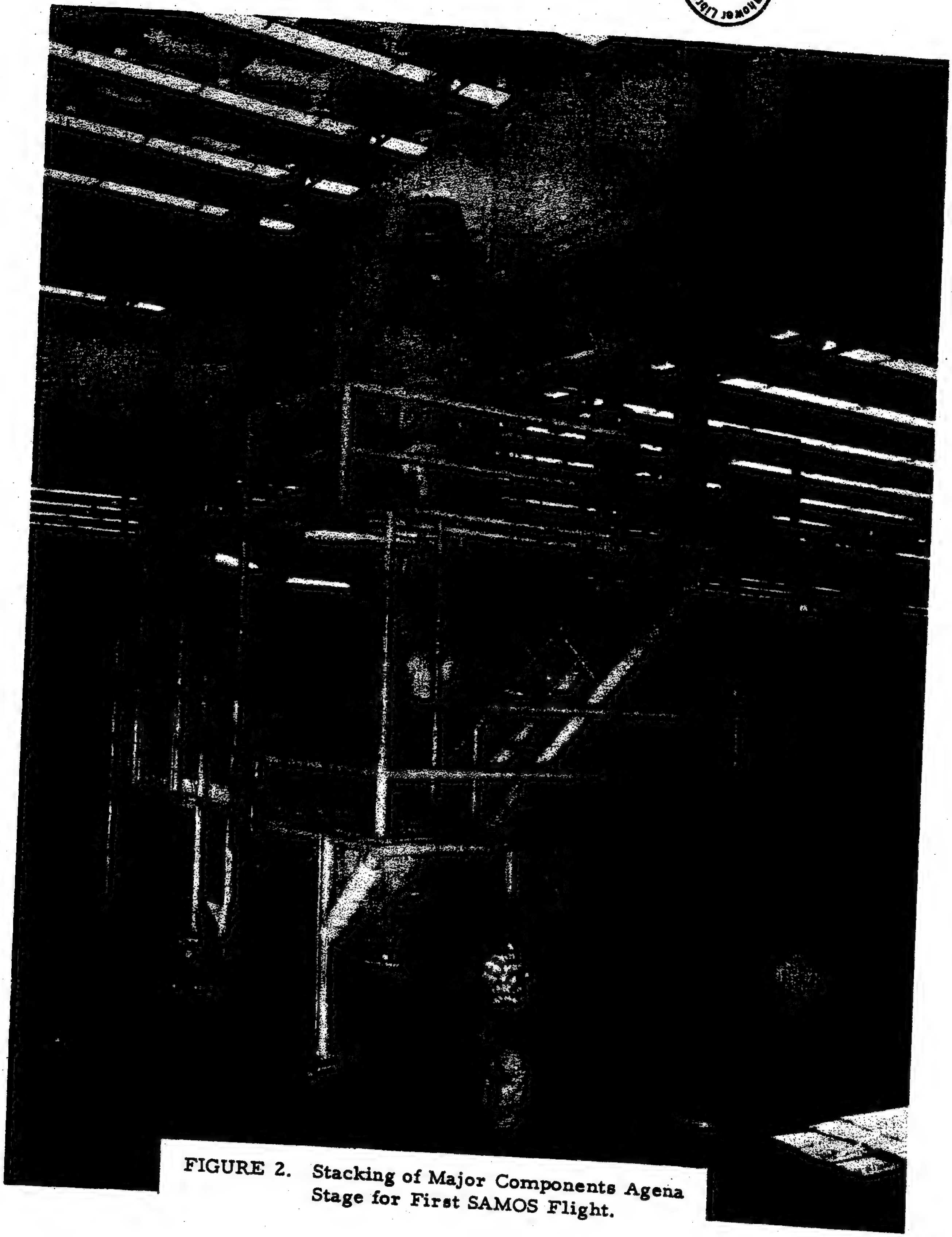

FIGURE 2. Stacking of Major Components Agena Stage for First SAMOS Flight.

MIDAS PROJECT

(VERY EARLY WARNING SATELLITE)

INTRODUCTION

MIDAS will provide early warning of ballistic missile attack.

The MIDAS project is aimed toward establishing a reliable, operational satellite-borne missile alarm capability in the 1962 time period. The MIDAS project (Missile Defense Alarm System) will place a series of satellites around the earth in polar orbits. These will carry payloads consisting of infrared detection scanners capable of detecting emanations from ballistic missiles being launched, as the missiles rise above the atmosphere.

CURRENT STATUS

GENERAL

Flight schedule revised to permit earlier attainment of objectives.

The MIDAS flight schedule was revised early in the quarter to realize higher altitude flights earlier in the development program. Commencing with Flight 3, MIDAS satellites will be launched into circular polar orbits of 2,000 nautical miles altitude. The 1,000 nautical mile orbit flight has been eliminated. Flights 1 and 2 remain unchanged at 261 nautical miles, with Flight 1 scheduled in February. The slippage reflected in this date was caused by delay in obtaining occupancy of an Atlantic Missile Range launch pad.

MIDAS COMPONENTS

AGENA vehicle being prepared at AMR for first flight.

The AGENA second stage vehicle for the first MIDAS flight test vehicle was hot fired at Santa Cruz Test Base (SCTB) on October 23, 1959. On November 30, 1959, a successful full-duration hot firing was conducted. It is now being prepared for launch at the Atlantic Missile Range. The AGENA vehicle for the second flight is being prepared for acceptance hot firing at Santa Cruz.

Common design possible for MIDAS and SAMOS airframes.

Design studies conducted during the quarter indicate the feasibility of a common MIDAS/SAMOS airframe design (from the forward end of the forward equipment rack aft) for flights 3 and subsequent. Equipment installations need not be interchangeable.

Aerojet-General equipment deliveries completed.

On December 14, 1959, the fourth and final unit of the initial (Aerojet-General) scanner configuration was delivered to the Lockheed Missile and Space Division following acceptance testing. The second unit and the data link van are at the Atlantic Missile Range. (An Aerojet-General infrared scanner is shown in Figure 3.)

Baird Scanner unit thermal tests conducted.

High altitude temperature simulation tests of the thermomechanical model of the Baird-Atomic scanner unit were conducted early in December.

Use of pyrotechnic targets evaluated.

Detailed test plans are being formulated for using pyrotechnics on the ground for MIDAS target. Minimum permissible burning time would be 30 seconds, assuring at least one "look" by the orbiting MIDAS scanner in the full scan mode.

FACILITIES

Integration of MIDAS/BMEWS facilities considered.

A preliminary determination has been made that Ballistic Missile Early Warning forward site computers were too heavily loaded to permit the processing of raw MIDAS data; that MIDAS could use BMEWS communications routes but not necessarily the same terminal equipment; and that mutual electronic interference considerations made it impractical for MIDAS and BMEWS to share forward site buildings.

Summary of construction progress for MIDAS program facilities.

1. North Pacific Station, Alaska. Construction of the various facilities is on schedule with completion planned on an incremental basis between June and October 1960.

2. North Atlantic Station. Studies are being continued to locate a suitable site for this station.

3. East Atlantic Station. Action has been initiated to obtain use of RAF Station Kirkbride as the site of this station.

4. New Boston Station. Final acceptance inspection of Angle Tracker, Command Transmitter, and UHF Telemetry Receiver facilities was accomplished in November 1959. The remaining facilities are scheduled for completion incrementally between February and September 1960.

5. Ottumwa, Iowa Station. Plans and specifications for the technical facilities for the station are complete and ready for advertising.

6. Satellite Test Center, Sunnyvale, California. Increment one of this center (formerly Development Control Center) was completed and accepted from the construction agency during December. Increment two is scheduled for completion in June 1960.

7. Space Operations Control and Data Processing Facility, Offutt AFB (formerly Technical Operations Control and Processing Center. Design was initiated in October 1959 and is scheduled to be completed in March 1960.

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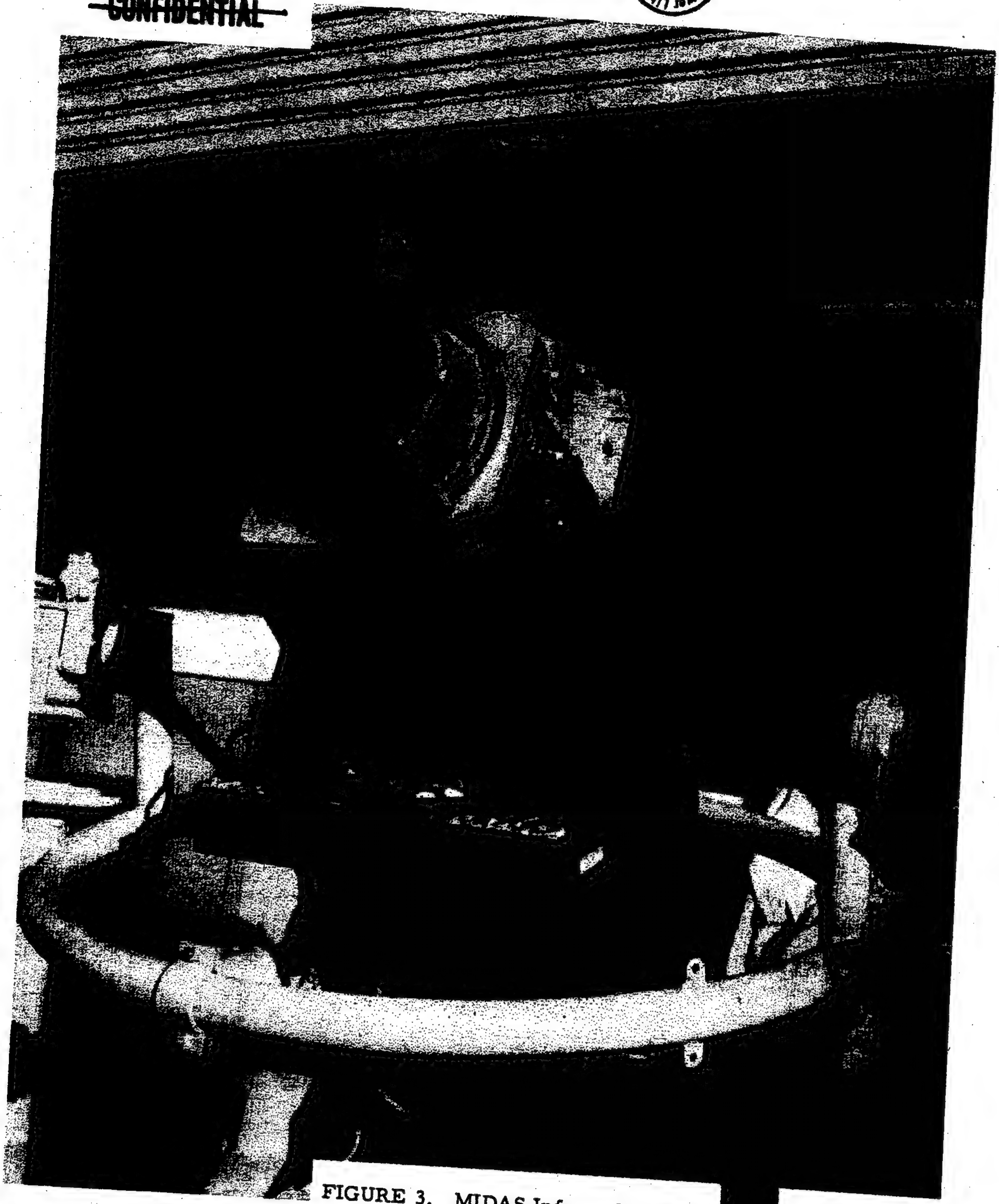

FIGURE 3. MIDAS Infrared Scanner

~~CONFIDENTIAL~~

PROJECT TRANSIT

(NAVIGATION SATELLITE)

INTRODUCTION

Objectives

Objective of the Navigation Satellite Project (TRANSIT) is to provide a global all-weather means of fixing precisely the position of mobile missile launching platforms such as surface craft, submarines and aircraft to an accuracy of 0.2 nautical miles.

NAVIGATION SATELLITE FLIGHTS

Analysis of data on TRANSIT IA discloses important objectives achieved.

The TRANSIT IA satellite was launched from the Atlantic Missile Range on September 17, 1959. This satellite was the first in the planned series of TRANSIT experiments. All components of the satellite operated satisfactorily during the launching and subsequent ballistic trajectory. In spite of the failure to place the satellite into orbit, valuable data were obtained concerning the operation of satellite and ground station equipment. These data provided the following useful informatio

1. An accurate determination of the satellite trajectory by means of Doppler tracking.

2. A preliminary appraisal of refraction effects.

3. A quantitative evaluation of the stability and accuracy of the frequency generating and measuring equipment.

4. A preliminary evaluation of TRANSIT navigation capability.

FUTURE LAUNCHES

TRANSIT 1B is scheduled to be launched in April 1960,

Two TRANSIT 1B satellites are being fabricated and tested in preparation for the launching in April 1960. TRANSIT 1B will transmit on four frequencies: 54, 162, 216, and 324 mc. By using a new command receiver switching circuit, it will be possible to transit four frequency data for short periods of time even after the energy in the chemical (silver-zinc) batteries has been depleted. An assembled TRANSIT 1B satellite installed in its flight shroud is shown in Figure 4. TRANSIT type oscillators will be installed on the next three DISCOVERER satellites. This will provide an opportunity for additional testing of the TRANSIT tracking system.

Launching scheduled for May 1960.

The TRANSIT 2A satellite, scheduled to be launched in May 1960, incorporates several functional and structural changes. The 2A satellite will depend entirely on solar power used in conjunction with nickel-cadmium batteries to supply 10 watts of operating power. An electronic clock running from the 3-mc stable oscillator will be used in the telemeter system and will also provide a means for accurate time correlation between ground stations. The total payload weight is 265 pounds including the GREB, pick-a-back, satellite.

Light-weight TRANSIT satellite being designed for operational use.

Operational TRANSIT satellites and prototype configurations immediately preceding them will weigh between 50 and 100 pounds. Current versions of the NASA SCOUT vehicle appear to meet the basic requirements for launching these satellites. Use of SCOUT will substantially reduce the cost of launching TRANSIT satellites. Several launchings are planned for Fiscal Year 1961 using this vehicle with lighter and smaller TRANSIT satellites currently being designed.

TELEMETRY AND TRACKING

Receiving Stations- The Lasham, England, station is being fully instrumented.

At present there are five fully instrumented ground stations. The sixth TRANSIT station at Lasham, England, will be completely equipped by June 1960. The Naval Ordnance Test Station (NOTS) at China Lake, California, has started construction of eight additional ground stations which the TRANSIT satellite can use. These stations represent an advance, in that instrumentation designed specifically for the TRANSIT application will replace general purpose commerical units.

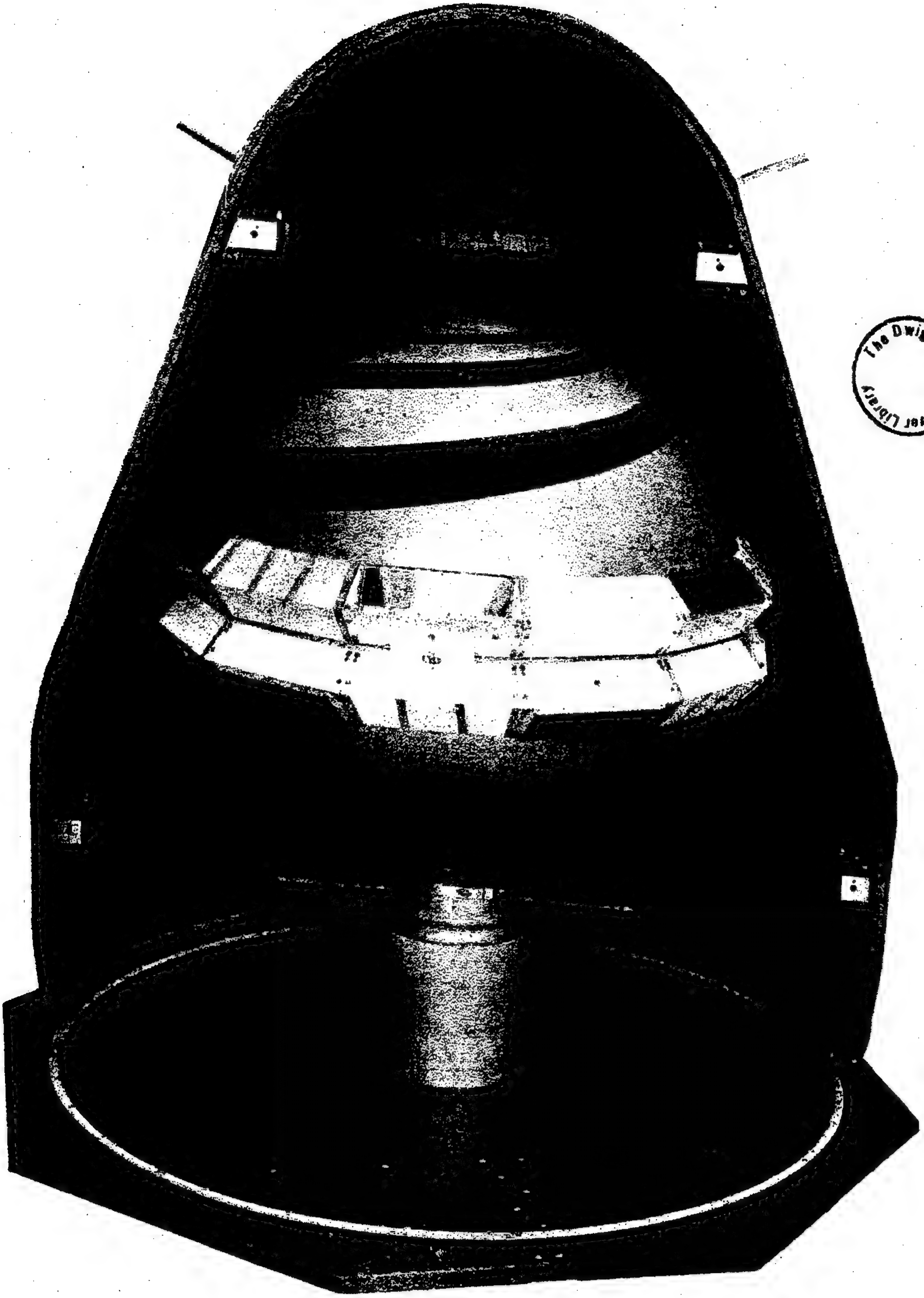

FIGURE 4. TRANSIT Satellite in Shroud

PROJECT NOTUS

(COMMUNICATION SATELLITES)

INTRODUCTION

Satellites to be used for receiving and retransmitting messages.

The objective of the Communication Satellite Project (NOTUS) is the development of a communication system, utilizing satellites to provide long range radio communication links. The satellite communication system is expected to relieve the presently overcrowded trunking facilities and to improve reliability of global communication.

Project being re-evaluated.

The Communication Satellite Program is being re-evaluated. Program decisions reached will be included in the next report.

DELAYED REPEATER

COURIER - Delayed Repeater.

The initial phase of the project is the development of an operational delayed repeater satellite (COURIER) which receives messages over one point and retransmits them over another.

INSTANTANEOUS REPEATER

The advanced system consists of three phases:

STEER - Strategic Polar Communications Satellite.

1. STEER - Strategic Polar Communications Satellite. Design, development and launching of four instantaneous communications satellites into six-hour polar orbits to obtain two-way communications, through the satellite, between ground stations in the United States and Strategic Air Command aircraft flying in the northern polar region.

TACKLE - Advanced Polar Communications.

2. TACKLE - Advanced Polar Communications Satellite. An interim program to use a STEER developed test bed for the early development and testing of components to be used in Project DECREE. Project TACKLE will be

consolidated with Project DECREE and will be flight tested on the last three CENTAUR R&D flight test vehicles.

DECREE - 24-hour Communications Satellite.

3. DECREE - Global (24-hour) Communications Satellite. Design, development and launching of seven satellites into 24-hour equatorial orbits to obtain broad-band, point-to-point, communication and ground-to-aircraft communication.

CURRENT STATUS

GENERAL

All design plans approved; equipment fabrication is under way.

Design plans submitted by the three contractors (ITT Labs for the ground complex, Radiation Laboratories for the ground antenna, and Philco for the satellite) were approved and the contractors are proceeding with fabrication of equipment and systems. Work on all phases is on schedule with the exception of the satellite contract where some program slippage has occurred.

The first complete component and systems tests for the first phase of the COURIER program are planned for March 1960.

FACILITIES AND SITES

Construction of the Puerto Rico site under way.

The concrete tower foundation of the Camp Salmas, Puerto Rico site has been completed, and installation of the commercial power line and security fence is currently in progress.

No action on Spanish site.

Action to implement use of the site at Torrejon Air Force Base, Madrid, Spain, has been withheld pending site negotiations.

Equipment fabrication in progress at contractors' plants.

Final circuit and mechanical design for the ground station complex is 90 percent complete. All equipment units have been breadboarded and are operating satisfactorily. The vans are expected to be delivered to the subcontractor in January 1960 and completed vans are scheduled to be sent to the sites by May 1, 1960. A final system assembly of the antenna tower and reflector equipment will be completed in January 1960 and in-plant component and system tests will begin.

SATELLITE EQUIPMENT

Reliability improvement.

A proposed Reliability Improvement Program for the COURIER payload provides for increased confidence in reliability and is predicated upon procurement of an additional test satellite and facilities. A delay in the COURIER 1A launch until approximately September 1960 may result if this proposal is approved.

COURIER system capacity now estimated to be in excess of 12 million bits per ground station orbit.

Development of the satellite recorder/play back equipment and the ground station data readout equipment has progressed to a point that permits a re-determination of COURIER system capacity. It is currently believed that the original estimate of 6 million bits per ground station per orbit is too conservative and that the COURIER system will have a capacity in excess of 12 million bits per ground station per orbit.

Equipment being fabricated at Philco.

Components for the satellite package are all under development and are in the breadboard stage. Models will be built as soon as all tests, now in progress, are successfully completed.

PROJECT STEER

Trajectory studies define maximum payload weight.

Trajectory studies, using the most recent performance figures for the ATLAS/AGENA "B" combination have revealed a maximum payload capability of 600 pounds in a circular polar orbit of 6 hours. General Electric Company is re-evaluating the estimated weights of final stage vehicle components on a basis of this maximum weight.

Preliminary guidance and staging sequence determined.

The Space Technology Laboratory has studied the guidance and staging sequence of the ATLAS/AGENA "B" combination. The preliminary decision has been made for the Stage 1 General Electric guidance system to steer the ATLAS to achieve the required velocity vector direction.

PROJECT TACKLE AND DECREE

Cost reduction to be effected by use of available space on CENTAUR flights.

Payload space available on the last three flights of the CENTAUR R&D program will be used by Project DECREE for preliminary development and test of the satellite vehicle and communications payload. This will decrease booster costs by precluding the necessity of separate Project TACKLE launches and will provide the additional advantage of testing the satellite vehicle at the 24-hour altitude and possibly in the equatorial plane.

PROJECT SHEPHERD

(TRACKING NETWORK)

Objective

The objective of Project SHEPHERD is the establishment of an effective space vehicle detection system which will detect and identify all space objects. The system must also have the capability for orbit determination and future position prediction of space objects.

To accomplish this objective, a minitrack fence has been constructed to act as a principal sensor for the detection system. In addition, the Air Force has been assigned the responsibility for development of a National Space Surveillance Control Center (NSSCC) which will receive data from any and all sensor systems, compute space vehicle orbits, and issue position predictions. Finally, Project SHEPHERD calls for the development of a world-wide tracking network in cooperation with the National Aeronautics and Space Administration.

DOPLOC to be phased out.

A doppler system complex, known as DOPLOC, was used initially to complement the MINITRACK System. In late December, a decision was made to phase out both the R&D and operational aspects of the Doppler system. This decision was based on the determination that, as an interim detection system, MINITRACK is superior to DOPLOC.

CURRENT STATUS

Tracking of DISCOVERER VI, VII and VIII.

Data received on the Minitrack System indicates that DISCOVERER VI came down on October 20 and DISCOVERER VII on November 26. DISCOVERER VIII, launched on November 20, is still in orbit.

Navy furnished with weekly search ephemeris.

The Chief of Naval Operations has directed the establishment of a program to familiarize Fleet Commanders with the potential threat to naval operations imposed by hostile reconnaissance satellites. The Fleet is being provided with a weekly search ephemeris based on data from the Space Surveillance System.

MINITRACK furnishes data to NSSCC.

During the reporting period, the NRL MINITRACK system began to furnish observational data to the interim National Space Surveillance Control Center (NSSCC) located in Bedford, Massachusetts.

New NSSCC building occupied.

The new building at NSSCC was occupied on December 1, 1959. The IBM computer at NSSCC was also placed in operation during December.

Central transmitter site chosen.

As a result of preliminary surveys, the central transmitter site for the active MINITRACK System has been located at Lake Kickapoo, near Wichita Falls, Texas.

PROJECT LONGSIGHT

(FEASIBILITY STUDIES AND EXPLORATORY RESEARCH)

INTRODUCTION

Objective

A determination was made in several areas of advanced research that there were serious gaps in existing programs that might be of future military significance. This project resulted in coordinating and broadening the base of the basic effort to advance the state of the art, especially in space technology.

SPACE POWER SUPPLY

Progress continues on space power supply projects.

Progress continues in the literature search; formulation of theories and mathematical analyses; and in instrumenting for projects in energy sources, collection, storage, conversion, and in heat rejection.

SPACE PROPULSION

Space Propulsion projects continue.

Progress continues on about two dozen basic projects in advanced space propulsion. A contractor was selected for the necessary research and development of a demonstration ion engine of .01 pound thrust. The ORION nuclear pulse propulsion concept appears technically feasible and engineering practicability is being determined. A shock tube was developed that simulates the actual blast of a nuclear detonation.

SPACE MATERIALS, STRUCTURES, PHENOMENA, ELECTRONICS, GUIDANCE & CONTROL

About two dozen projects are proceeding satisfactorily in these areas important to the space environment. Although the effort is oriented toward solutions to problems related to future space operations, considerable application in other fields will result from this basic research.

~~SECRET~~

PROJECT TRIBE

(VEHICLE DEVELOPMENT AND MODIFICATION)

PROJECT SATURN

INTRODUCTION

SATURN to fill early need for orbiting large payloads.

Project SATURN evolved as the earliest possible solution to the urgent need for boosting large payloads into orbit. The Army Ordnance Missile Command was designated to provide a space vehicle booster capable of generating approximately 1.5 million pounds thrust.

Development Operations Division of ABMA and SATURN Program are to be transferred to NASA.

As a result of the President's decision to transfer the Development Operations Division of the Army Ballistic Missile Agency and the big booster program to the National Aeronautics and Space Administration, technical supervision for the program has been assumed by NASA under an agreement worked out between NASA and DoD. Administrative supervision of the program remains with ARPA and SATURN development remains the responsibility of AOMC until the transfer plan is approved by the Congress.

Booster contains eight Rocketdyne H-1 engines.

The SATURN booster consists of three main sections: the tail section, the container section, and the upper stage adaption section. The container section is made up of one JUPITER-type tank (105 inches diameter) for LOX, and eight REDSTONE-type tanks (70 inches diameter), surrounding it - four for LOX and four for fuel. The tail section contains eight Rocketdyne H-1 engines with a nominal sea-level thrust of 188,000 pounds each.

Recommendations made on configuration of upper stages.

Upper stages for the SATURN vehicle have been the subject of continued studies and review to determine an optimum configuration and a desirable growth sequence.

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A committee, chaired by NASA and including representatives from ARPA, the Air Force, Department of Defense, and ABMA, has recommended adoption of the ABMA "C" series SATURN development program. The group recommended that:

1. A long range development plan for the SATURN vehicle be established that will provide, through a consecutive development of "building block " upper stages, a substantial early payload capability and a final configuration that exploits the maximum capability of the SATURN first stage (booster). Vehicle reliability will be emphasized in the "building block" program through a continued use of each development stage in later vehicle configurations.
2. All upper stages be fueled with hydrogen-oxygen propellants.
3. The initial vehicle configuration consists of the following:
    a. The eight-engine first stage (booster) currently under development at ABMA.
    b. A newly-developed second stage with a diameter of 220 inches using four of the current CENTAUR engines uprated to 20, 000 pounds thrust each.
    c. A third stage with a diameter of 120 inches using the current CENTAUR stage (with two 15, 000-pound thrust engines) modified only as required for vehicle and payload attachments.
4. The following developments be initiated immediately:
    a. A 150, 000 to 200, 000 pound thrust hydrogen-oxygen fueled rocket engine for ultimate use in second and third stages of later SATURN vehicles of the "C" series.
    b. A design study of the hydrogen-oxygen upper stages using the 150, 000 to 200, 000 pound thrust engines as ultimate second and third stages of later SATURN vehicles of the "C" series.

CURRENT STATUS

GENERAL

The first full eight-engine captive firing of SA-T rescheduled from March to April 1960.

The current SATURN test schedule provides for one booster (SA-T) for captive test firings and one for each of four flight vehicles (SA-1, SA-2, SA-3, and SA-4). As a result of minor technical difficulties associated with prototype production, the full eight-engine captive firing of SA-T has been rescheduled from March to April 1960. Fabrication of SA-1 components has begun and no slippage is expected to result from the delay in the test vehicle. This rescheduling should have no effect on flight tests currently scheduled to begin in third quarter 1961.

Studies indicate the 24-hour communications satellite mission can be accomplished with one engine out.

Studies of first stage "engine-out" capabilities of a three stage SATURN vehicle with a 24-hour communications satellite mission have shown that the mission could be accomplished if one engine fails. A reduction of approximately 350 pounds in the optimum payload for 8 engines would permit a 350 pound propellant reserve for use in the event of one engine's failure. Propellant reserves for each flight will have to be determined by the particular mission and pay load requirements.

GUIDANCE AND CONTROL

All fabrication and assembly drawings have been released for SA-T.

All fabrication and assembly drawings have been released for SA-T. Minor layout modifications have been initiated to incorporate improvements in SA-1, SA-2, and SA-3.

Hydraulic actuators show satisfactory performance.

The first group of hydraulic actuators for the SATURN booster's control engines have been made available for testing in the laboratory and on SA-T. Satisfactory actuator performance has been achieved during several hot firings of H-1 engines on the ABMA Power Plant Test Stand.

Ice and rain shields for the SATURN booster have been designed.

Design of ice and rain shields for the booster, to be made of rubberized fiberglas material, has been completed. The shields greatly reduce formation of ice and snow on the LOX tanks and prevent the snow and ice from dropping into the tail area at liftoff.

PROPULSION

All SA-T engines have been delivered.

Delivery of five H-1 Production Engines during the reporting period completed delivery of all engines required for SA-T.

Several areas of investigation to improve performance are under way.

A number of studies are under way to provide improvements in the SATURN propulsion system. These include: Investigation of a dual ignition system for H-1 engines; Studies of engine aerodynamic loading; and Investigations of a monopropellant gas generator system.

TEST PROGRAM

Nine H-1 engines have been successfully tested at ABMA.

Testing of nine H-1 engines (H-1001 thru H-1009) for SA-T has been successfully completed at ABMA. There have been only minor malfunctions, and no major hardware changes were required.

Testing of the complete instrument compartment cooling system continued.

Testing of the complete instrument compartment cooling system was continued. Three test runs completed to date indicate that minor adjustments and modifications are necessary to prevent spot cooling and to improve circulation.

The simulated SATURN booster was installed in the ABMA Static Test Tower in a satisfactory checkout of handling techniques and various clearances. (see Fig. 5.)

RELIABILITY

Reliability test procedures are being established for SATURN components.

Reliability test procedures are being established for SATURN C components on which procurement action has been initiated. Completion of test procedures prior to component delivery will permit an early start on reliability testing.

Approximately 50 test fixtures are already available for testing of SATURN booster hardware.

Approximiately 50 test fixtures are already available for testing of hardware to be used on the captive test booster. The fixtures are generall adaptable for testing components for the first four flight boosters also.

BOOSTER TRANSPORTATION SYSTEM

A plan for transporting the SATURN Booster from ABMA to AMR has been devised.

A SATURN transportation plan covering movement of the booster from the Army Ballistic Missile Agency to the Atlantic Missile Range has been finalized. (See Fig. 6.) The SATURN booster will be towed on its wheeled transporter, already successfully road tested, over a reinforced road to the Redstone Arsenal docks on the Tennessee River. There is will be wheeled onto a roll-on, roll-off ocean-going barge, constructed so that it can also be used as an inland waterway carrier. The barge will be moved by river tug down the Tennessee, Ohio, and Mississippi Rivers to New Orleans. A sea-going vessel will take it across the Gulf and around Florida to Fort Pierce, Florida. An inland waterway tug will tow it up the Indian River to AMR. There the booster and transporter will be rolled off the barge and towed about one mile over a new road to the SATURN launch site.

Authorization given to initiate design of the roll-on, roll-off barge.

The Army Transportation Corps was authorized to initiate design of the roll-on, roll-off barge. This barge was chosen because it can make the entire trip to the launching site without intermediate moving of the booster.

BOOSTER RECOVERY

A plan has been devised for recovery of spent SATURN Boosters.

Recovery of the spent SATURN booster is currently envisioned as follows: A 57-foot diameter drogue chute will be used to slow the fall of the booster and deploy the three 108-foot diameter chutes. The 108-foot diameter chutes will reduce the booste rate of fall to 90-100 feet per second. Beginning at approximately 100 feet from the water, eight retro-rockets will be fired to reduce to zero degrees the vertical impact velocity. The booster will be floated into the flooded well area of a Landing Ship Dock (LSD) stationed near the impact area. The LSD will take the booster to a Florida port where it will be removed from the LSD by a crane and loaded into the special booster transportation barge. Tugs will then return the barge and booster to Redstone Arsenal.

Recovery parachute designs have been finalized.

Recovery parachute designs have been finalized. Parachute items with long-lead times have been ordered.

A 1/10 scale booster model was used in drop tests of the SATURN Booster.

A computer study of the water entry characteristics of the SATURN booster, and a drop test program using a 1/10 scale booster model have been completed. Analysis of drop-test results is in progress.

FACILITIES STATUS

CAPTIVE TEST FACILITIES

Work on the ABMA Static Test Tower is proceeding on schedule.

In-house work on the ABMA Static Test Tower is proceeding on schedule. No difficulty is anticipated in having this facility ready for the first full scale captive test firing in April 1960.

LAUNCH FACILITIES

A contract for construction of the SATURN complex has been awarded.

Launch complex construction was initiated following award of a contract in November covering construction of the launch pad and amplifier room, LOX storage area, fuel storage, and high pressure gas facility. Construction of the SATURN blockhouse, which was initiated earlier, is proceeding satisfactorily at the Atlantic Missile Range. (See Figure 7)

Methods of supplying liquid hydrogen to AMR are under study.

The choice oxygen-hydrogen powered upper stages for the SATURN vehicle calls for increased use of liquid hydrogen at an early date. Storage and transfer facilities at the Atlantic Missile Range are being planned. Required size and location of these facilities are under study.

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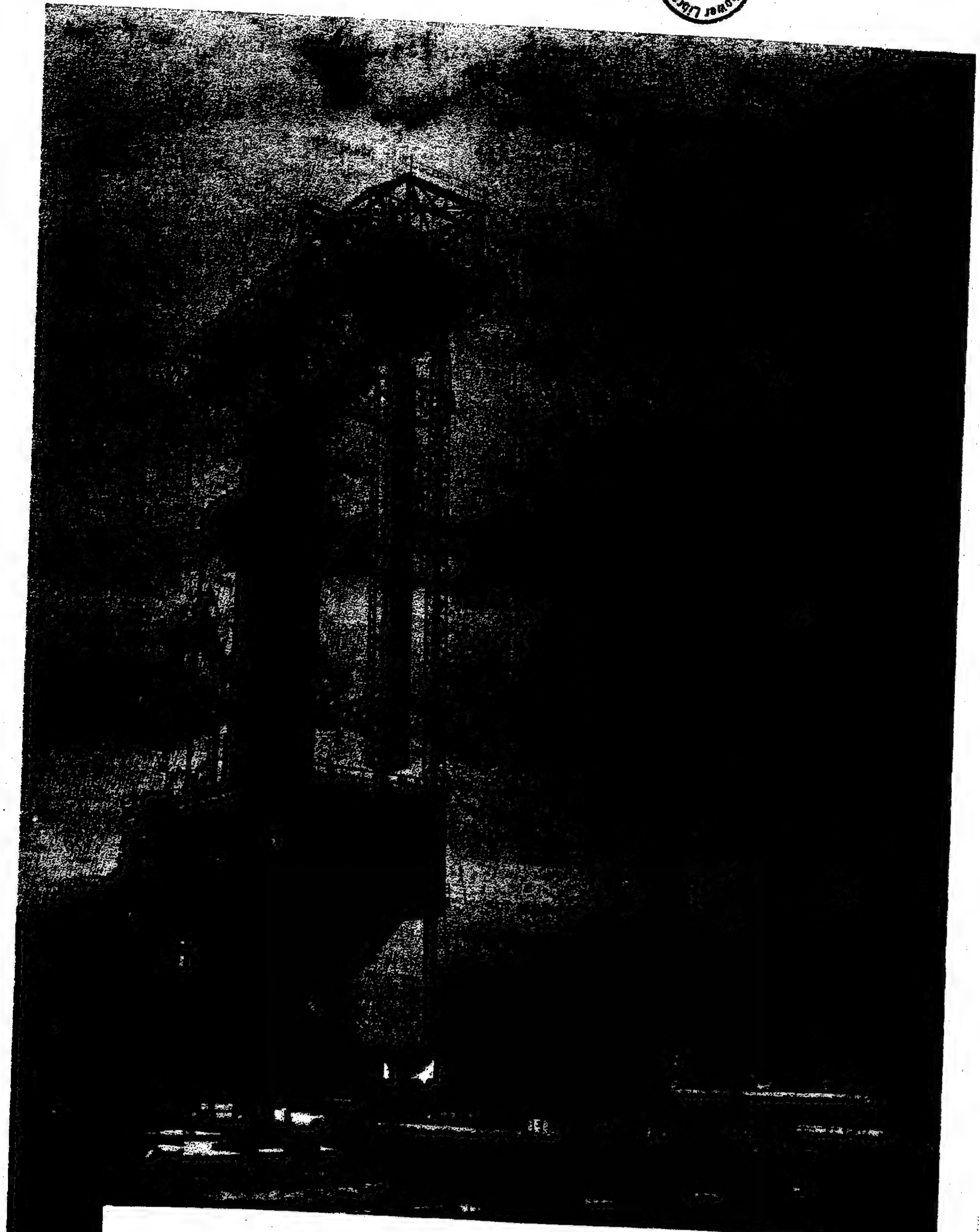

FIGURE 5. SATURN Simulated Booster at **ABMA** Static Test Tower.

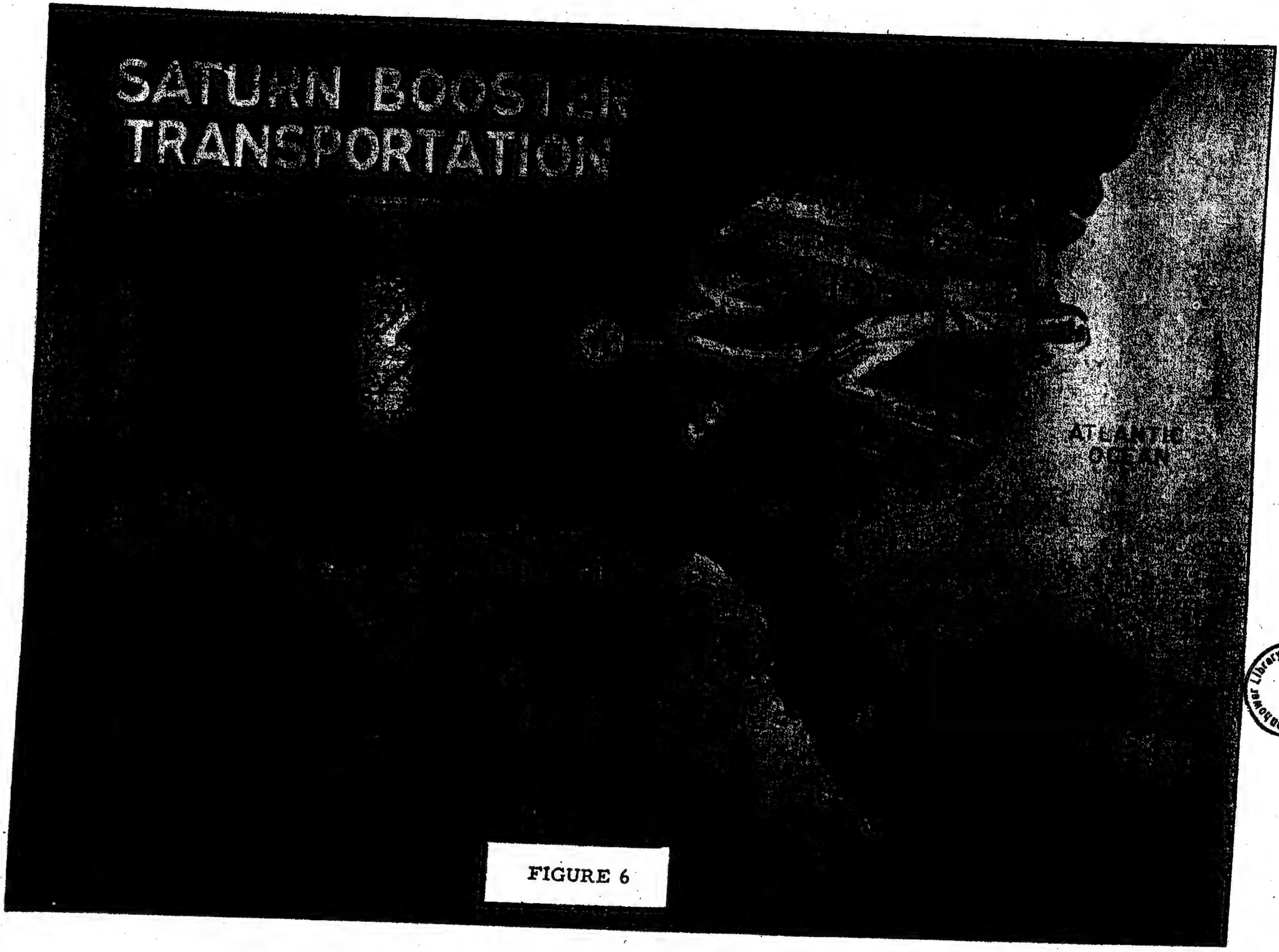

FIGURE 6

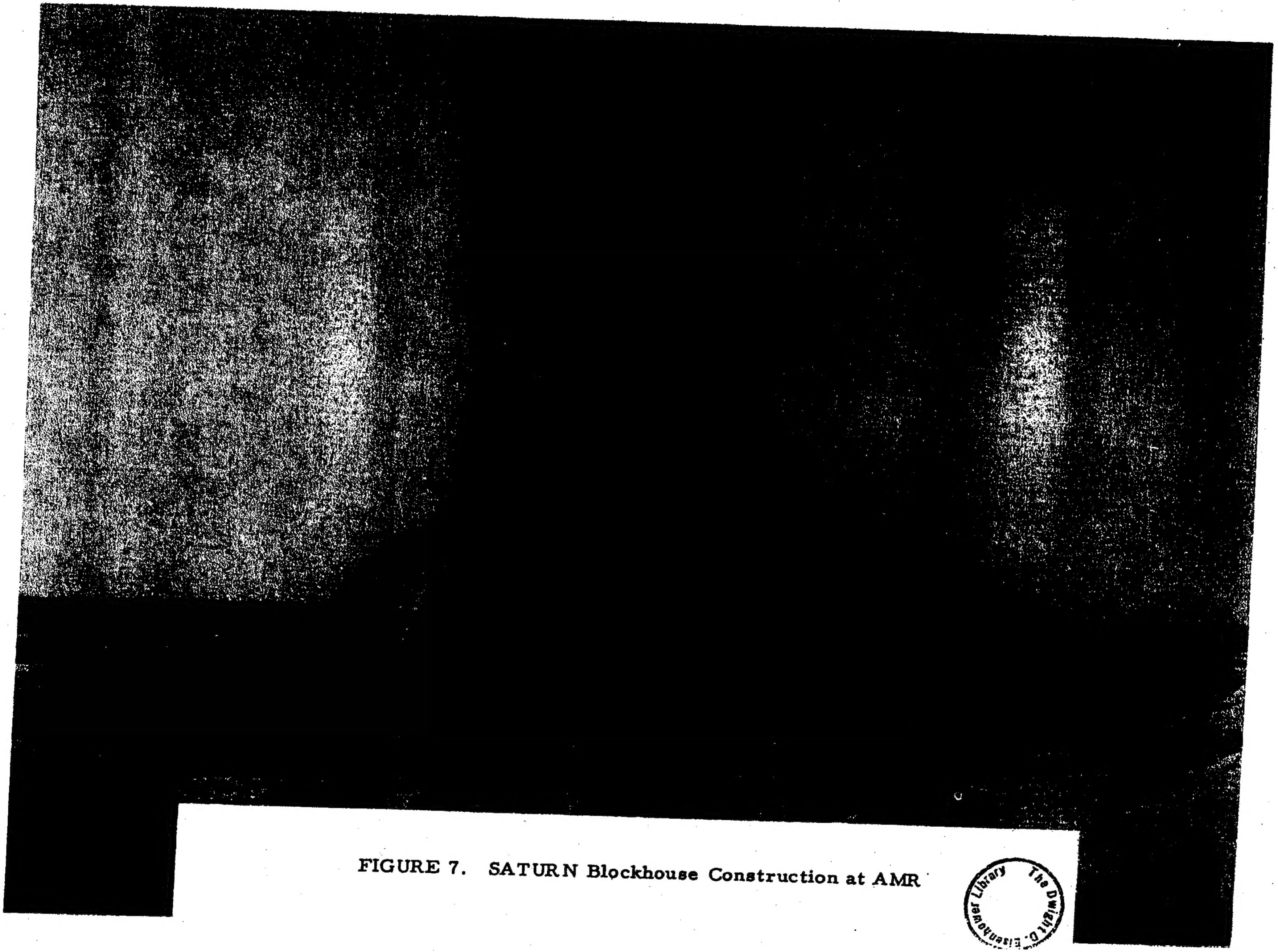

FIGURE 7. SATURN Blockhouse Construction at AMR

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STATUS OF FUNDS

(In Millions)
December 31, 1959

Project	Funded (ARPA Orders Issued) FY 1959 & Prior Years	Amounts Programmed FY 1960	Cumulative Obligations	Cumulative Expenditures
DISCOVERER 1/	$136.6	$ 66.6	$166.0	$143.2
SAMOS 1/	105.6	159.5	168.7	115.3
MIDAS 1/	22.8	46.9	39.9	19.8
Meteorological Satellite	12.8	--	11.4	10.4
Navigation Satellite	10.6	16.8	12.4	7.4
Cummunications Satellite	16.7	38.8	17.5	6.8
Tracking	31.9	12.0	29.6	14.1
Feasibility Studies	20.4	12.0	19.1	10.9
Vehicle Development and Modification				
SATURN	34.0	70.0	69.3	38.9
CENTAUR	21.5	--	21.5	16.0
Upper Stage Modification	4.3	4.9	4.3	3.1
Large Thrust Test Stand	.7	5.7	5.4	.5
TOTAL	$417.9	$433.2	$565.1	$386.4

1/ Excludes $84.1 programmed during Fiscal Year 1958 and prior years for WS 117L Program. DISCOVERER, SAMOS and MIDAS projects are outgrowths of WS 117L.

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DOD SATELLITE LAUNCH SCHEDULE

Program	Vehicle	Launch Site	FY 1961 1960 Quarters 1	2	3	4	FY 1962 1961 Quarters 1	2	3	4	FY 1963 1962 Quarters 1	2	3	4
1. DISCOVERER	Thor-Agena	PMR	6	6	6	2								
2. Reconnaissance (SAMOS)	Atlas-Agena	PMR		1	2	2	2	1	3	3	3	1		
3. Communications (NOTUS) a. Delayed Repeater														
(COURIER I)	Thor-Epsilon	AMR		1	1									
(COURIER II)	Thor-Agena	AMR							1	1				
(COURIER III)	Atlas-Agena	AMR											1	1
b. SAC Polar (STEER)	Atlas-Agena	PMR					1	1	1	1				
c. Adv. Polar (TACKLE)	Atlas-Agena	PMR									2	1	1	
d. 24 Hour (DECREE)	Atlas-Centaur	AMR	Tentative								1	2	1	1
4. Navigation (TRANSIT) TRANSIT I, II TRANSIT III, IV	Thor-Epsilon	AMR		2	1		1/							
5. Early Warning (MIDAS)														
Phase I	Atlas-Agena	AMR	1	1										
Phase II	Atlas-Agena	PMR			1	1	1	1	2	2				
6. SATURN	SATURN-Dummy	AMR							1 2/	1 2/			1	

1/ Payload planned to be launched together with some other programmed payload.
2/ Launch of vehicle with dummy upper stage, but without payload.

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MILITARY SPACE PROJECTS

FLIGHT DATA ON

SATELLITES ACHIEVING ORBIT

DISCOVERER FLIGHTS

DISCOVERER VII (206-1051)

Date Launched: November 7, 1959
Booster: THOR #206, IRBM
Gross Weight: 117,200 lbs.
Payload Weight: 300 lbs.
Perigee: 103 Statute Miles
Apogee: 505 Statute Miles
Eccentricity: .05
Period: 94.42 minutes
Payload: Mark II biomedical recovery capsule

Subsystems: Airframe, Propulsion, Auxiliary Power, Guidance and Biomedical
Second Stage: DISCOVERER Vehicle
On-Orbit Weight: 1,753 lbs.
Propulsion: XLR81-Be-5 Engine
Fuel: Unsymmetrical Di-Methyl Hydrazine/Inhibited Red Fuming Nitric Acid
Flight Characteristics: Ballistic trajectory to orbit.

DISCOVERER VIII (212-1050)

Date Launched: November 20, 1959
Booster: THOR #212, IRBM
Gross Weight: 117,200 lbs.
Payload Weight: 300 lbs.
Perigee: 120 Statute Miles
Apogee: 1026 Statute Miles
Eccentricity: .10
Period: 103.67 Minutes
Payload: Mark II biomedical recovery capsule

Subsystems: Airframe, Propulsion, Auxiliary Power, Guidance and Biomedical
Second Stage: DISCOVERER Vehicle
On-Orbit Weight: 1,750 lbs.
Propulsion: XLR81-Be-5 Engine
Fuel: Unsymmetrical Di-Methyl Hydrazine/Inhibited Red Fuming Nitric Acid
Flight Characteristics: Ballistic trajectory to orbit.